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[54]名 稱：變壓器及其線圈捲繞方法
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[72]發明人：
施屈帝 瑞典
賀爾柏格 瑞典
布蘭奇法爾特 瑞典
薩賽 瑞典
卡斯頓森 瑞典
[71]申請人：
艾皮皮艾皮公司 瑞典
[74]代理人：俞大衛 先生

[57]申請專利範圍：

1. 一種變壓器，其係至少由一組以上的高壓線圈以及一組以上的低壓線圈所組成，其特徵為：上述每一線圈內均設有一「其中納有電場圍堵組元」，但其本身可供磁場穿越的撓性導體，且該等線圈係互相混淆，即高壓線圈可與低壓線圈互相混淆。
2. 根據申請專利範圍第1項的變壓器，其特徵為：其中所稱的低壓線圈係纏繞成坐定於兩個相對應的相毗鄰高壓線圈層之間的一低壓線圈層。
3. 根據申請專利範圍第1項或第2項的變壓器，其特徵為：其中所稱的線圈係配置於一由高壓線圈層，繼之以一低壓線圈層，兩個高壓線圈層，一個低壓線圈層，再繼之以兩個高壓線圈層所組成的週期性結構之內。
4. 根據申請專利範圍第1項或第2項的變壓器，其特徵為：至少有一部份的低壓線圈中的每一線圈，係均分成數個彼此並聯的小圈，以減少高壓線圈數量與低壓線圈總數量間的差異。
5. 根據申請專利範圍第4項的變壓器，其特徵為：低壓線圈中的每一線圈係均分為數量與高壓線圈的數量相同的彼此平行的小圈。
6. 根據申請專利範圍第5項的變壓器，其特徵為：高壓線圈及低壓線圈係對稱地配置成自其截切面觀之，呈一棋盤樣型的狀態。
7. 根據申請專利範圍第1項或第2項的變壓器，其特徵為：其中所稱的導體組元，係由電導性中央部位，一在該電導性的中央部位周圍具有半導體作用的第一層、一在該第一層的周圍所提供的固態絕緣層，以及有一在該絕緣層的周圍具

有半導體作用的第二層納入其內的電場圍堵組元所構成。

8. 根據申請專利範圍第7項的變壓器，其特徵為：其中所稱的第一層的電位大致上與電導體的電位相同。

9. 根據申請專利範圍第7項的變壓器，其特徵為：其中所稱的第二層係配置成一在前述電導體的周圍建立有一大致上為等電位的表面。

10. 根據申請專利範圍第9項的變壓器，其特徵為：其中所稱的第二層乃連接至一事先設定的電位上。

11. 根據申請專利範圍第10項的變壓器，其特徵為：其中所稱的事先設定的電位係指地電位。

12. 根據申請專利範圍第7項的變壓器，其特徵為：至少有兩個相毗鄰的層體，其熱膨脹係數大致相同。

13. 根據申請專利範圍第7項的變壓器，其特徵為：其中所稱的中央導體組元係由數串股線所組成，且其中只有少數的股線是彼此形成電氣接觸。

14. 根據申請專利範圍第7項的變壓器，其特徵為：其中所稱的三層的每一層均大致上沿整個接續表面而固接至相毗鄰的其他兩層上。

15. 根據申請專利範圍第7項的變壓器，其特徵為：其中所稱的電導體內亦設有一金屬罩蔽及一鞘。

16. 根據申請專利範圍第7項的變壓器，其特徵為：中央導體組元的截面積乃在80～3000mm^{2}之間。

17. 根據申請專利範圍第7項的變壓器，其特徵為：其中所稱的導體外徑之值乃在

20～250mm之間。

18. 根據申請專利範圍第1項或第2項的變壓器，其特徵為：其中所稱的層片磁材的樑體(27)，係位於線圈之間。

19. 根據申請專利範圍第1項或第2項的變壓器，其特徵為：其中所稱的將電場圍堵於其中的組元，其設計的耐壓幅度，至少在10kV以上，甚至是在36kV以上，最好是在72.5kV以上乃至於極高的傳輸電壓位準，例如400kV至800kV或更高的電壓。

20. 根據申請專利範圍第1項或第2項的變壓器，其特徵為：其中所稱的電場圍堵組元，其設計的功率範圍乃在0.5MVA以上，最好能在30 MVA以上，甚至於高到1000 MVA。

21. 一種變壓器的線圈纏繞方法，其步驟包括同時纏繞其內設有電場圍堵組元，但又可由磁場穿透的高、低壓撓性導體，以使高壓線圈及低壓線圈互相纏繞混淆。

22. 根據申請專利範圍第21項的方法，其特徵為：高壓及低壓導體乃分別同時從各自的筒體上解繞，然後再纏繞至一變壓器筒體上。

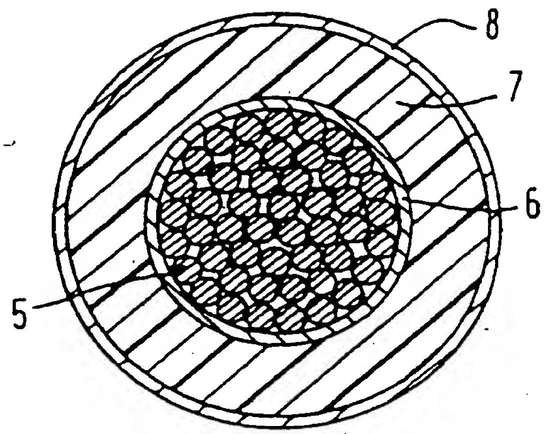
圖式簡單說明：

第一圖為本發明變壓器的線圈中所使用電纜的一實施例。

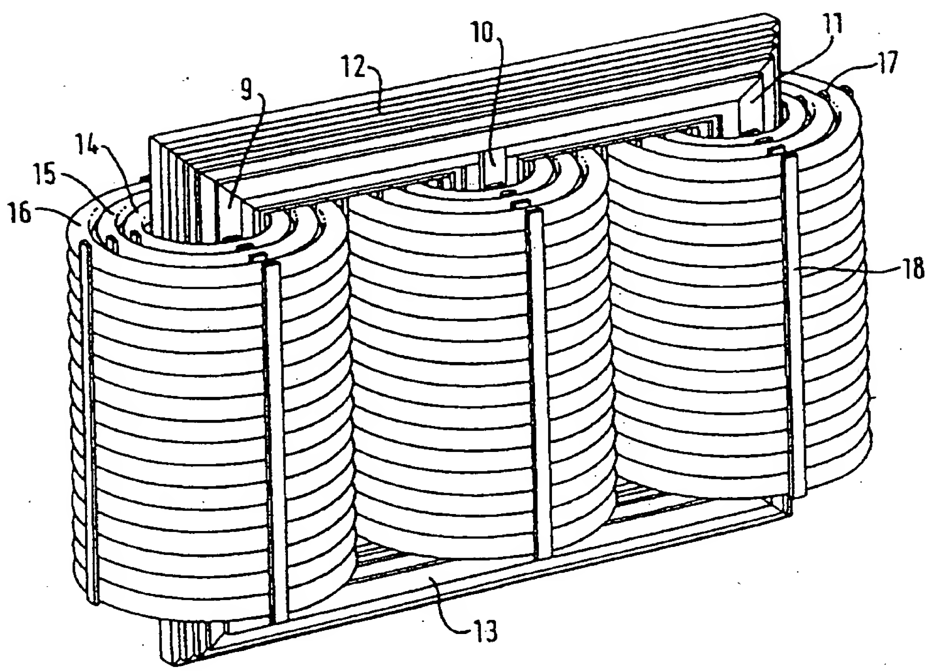
第二圖為一傳統造型的三相變壓器。

第三圖及第四圖分別為本發明變壓器的高低壓線圈之不同配置實施例的截面示意圖。

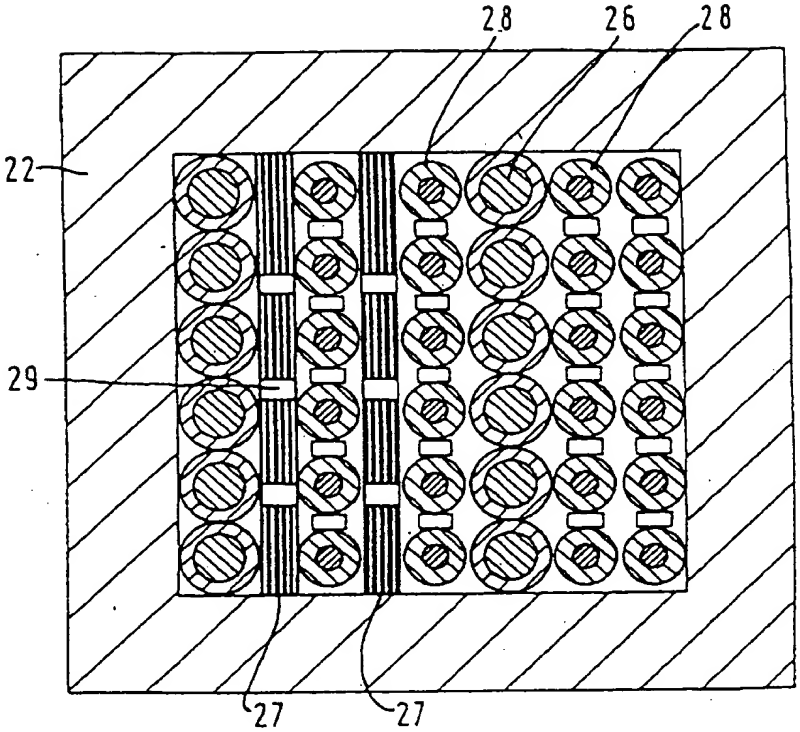
第五圖為變壓器的一線圈纏繞方法示意圖。



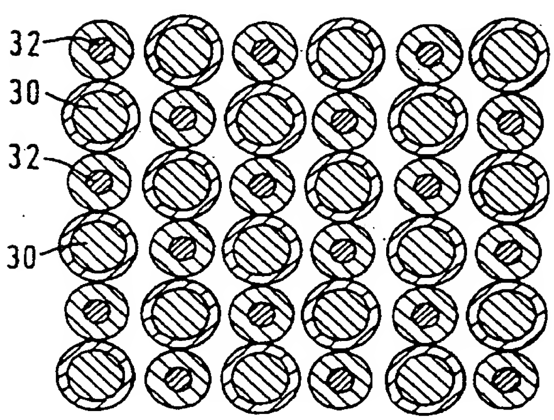
第一圖



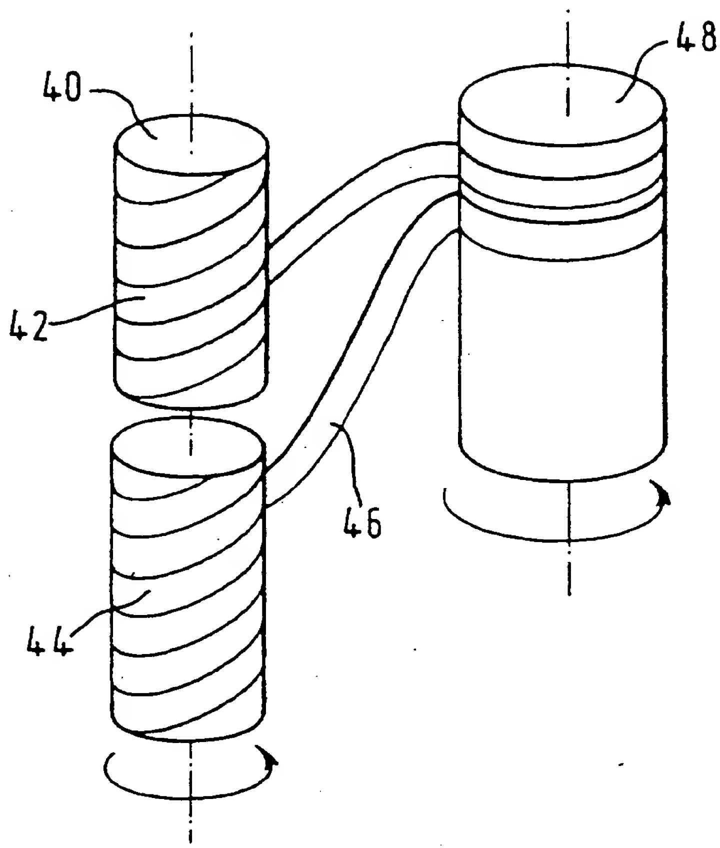
第二圖



第三圖



第四圖



第五圖

結構上，該結構具有一開口以備套入該鐵心，該鐵心之形成係由一很薄的非晶金屬膜，該方法包括：

(a) 將該膜繞成一螺旋鐵心結構其具有以窗爲中心將疊層加在其上；

(b) 將該鐵心結構次分爲許多疊層組，該組係堆積起來以形成該鐵心結構；

(c) 在該鐵心結構之每一其他組之疊層中產生第一次割切，沿鐵心結構在其他組之疊層中之每一割切向該膜之中心線之一方向傾斜一稍不同於90° 之角度；

(d) 沿插入其他組間之鐵心結構，由每一組之疊層產生第二個割切，每一沿該鐵心結構之插入組疊層中之每一第二割切均向膜之中心線傾斜，其方向爲稍不同於90° 之角度而相反於該一方向；

(e) 將該疊層在該割切處分離並將該鐵心結構變成U型結構，其臂部在該割切處終止；

(f) 將該線圈結構套入U型結構之臂部；

(g) 以疊層分開之兩端傾斜間之差爲準，將該組之疊層末端再予接合，逐組爲之，僅將每一組疊層之末端與同組疊層之相反末端相鄰接，該組次命名之末端即在該處分開，因而阻止了一組疊層末端與鄰近組疊層末端相結合。

7. 一種製作變壓器之方法，該變壓器具有一鐵心及線圈裝置，線圈之各匝係繞在一積體線圈結構上，該線圈結構有一開口以備套入該鐵心上，該鐵心係由很薄的磁性非晶金屬膜構成，該製作方法包括：

(a) 將該膜繞成螺旋體結構之鐵心上，此結構有許多以窗爲準的堆積之疊層；

(b) 將該鐵心結構次分成疊層組，各組堆積起來以形成該鐵心結構；

(c) 在鐵心結構每一其他組之疊層中產生第一個割切，在其他組疊層中每一割切均以稍不同於90° 角度之方向傾向於該膜之中心線；

(d) 在插入交互組之該鐵心結構之疊層中產生第二個割切，每一第二個割切與經由第一個割切之膜縱向中心線成一不同角度；

(e) 在該割切處將該疊層分開並將鐵心結構變成U型結構，其臂部即終止在該割切之處；

(f) 將該線圈結構套入該U型結構之臂部；

(g) 以與第一個割切膜之縱向中心線之傾斜角與第二個割切角之差爲導引，再接合該組疊層之末端，僅將每組疊層末端與同組疊層之相反末端相鄰接，該第一命名之末端即在該處分開，因而阻止了一組疊層之末端與鄰近組疊層末端之結合。

8. 根據申請專利範圍第7項之方法包括次分類每組爲沿膜成縱向彼此分開之各級，並產生第一個及第二個割切，每一割切均會在各級中之割切沿膜之縱向中心分離，以其他組言，與膜之縱向中心線成第一角，對插入組言，與膜之縱向中心線成第二角。

9. 一種製造能減低損失之變壓器之方法，該方法含：

(a) 在磁性非晶金屬膜上繞線成一螺旋結構其中心有一窗形物；

(b) 將該螺旋體之各匝次分爲許多組，每組再次分爲許多級；

(c) 在該螺旋之一區域中每組之各級中產生系列割切，每組之各級之割切在預定之方向沿該膜在縱向上開隔開；一組中一級之割切與後續級之割切之結束係以每組每級之最後一匝及該組後續級之第一匝互相重疊之方式，因此流經該最後匝及經過第一匝之磁通將經由該割切區域內該最后及第一匝之一及其他共同傳導，在該區域內產生擁擠之磁通線，該割切產生於該膜之所有組中；

(d) 在該割切處分開該螺旋體；

(e) 之後將該螺旋體變成U型結構；

(f) 將該線圈套入該U型結構之臂部；

(g) 在該割切區域內將該組再閉合，因而產生一具有再閉合之螺旋；

該方法之特徵爲經由各級之割切以稍不同於90° 之角度向該縱向中心線傾斜；因而在該磁通線擁擠區域鐵心之面積即有

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POWER TRANSFORMER AND METHOD OF WINDING THE SAME

The present invention relates to a power transformer comprising at least one high voltage winding and one low voltage winding.

The term "power transformer" as used herein means a transformer having a rated output from a few hundred kVA to more than 1000 MVA and a rated voltage from 3-4 kV to very high transmission voltages, e.g. from 400-800 kV or higher.

Conventional power transformers are described in e.g. A.C.Franklin and D.P.Franklin, "The J & P Transformer Book, A Practical Technology of the Power Transformer", published by Butterworths, 11th edition, 1990. Problems related to internal electric insulation and related topics are discussed in e.g. H.P.Moser, "Transformerboard, Die Verwendung von Transformerboard in Grossleistungstransformatoren", published by H.Weidman AG, Rapperswil mit Gesamtherstellung: Birkhäuser AG, Basle, Switzerland.

In transmission and distribution of electric energy transformers are exclusively used for enabling exchange of electric energy between two or more electric systems. Transformers are available for powers from the 1 MVA region to the 1000 MVA region and for voltages up to the highest transmission voltages used today.

Conventional power transformers comprise a transformer core, often formed of laminated commonly oriented sheet, normally of silicon iron. The core is formed of a number of legs connected by yokes which together form one or more core windows. Transformers having such a core are usually called core transformers. A number of windings are provided around the core legs. In power transformers these windings are almost always arranged in a concentric configuration and distributed along the length of the core leg.

Other types of core structures are, however, known, e.g. so-called shell transformer structures, which normally have rectangular windings and rectangular leg sections disposed outside the windings.

Air-cooled conventional power transformers for lower power ranges are known. To render these transformers screen-protected an outer casing is often provided, which also reduces the external magnetic fields from the transformers.

Most power transformers are, however, oil-cooled the oil also serving as an insulating medium. An oil-cooled and oil-insulated conventional transformer is enclosed in an outer case which has to fulfil heavy demands. The construction of such a transformer with its associated circuit couplers, breaker elements and bushings is therefore complicated. The use of oil for cooling and insulation also complicates service of the transformer and constitutes an environmental hazard.

A so-called "dry" transformer without oil insulation and oil cooling and adapted for rated powers up to 1000 MVA with rated voltages from 3-4 kV and up to very high transmission voltages comprises windings formed from conductors such as shown in Figure 1. The conductor comprises central conductive means composed of a number of non-insulated (and optionally some insulated) wire strands 5. Around the conductive means there is an inner semiconducting casing 6 which is in contact with at least some of the non-insulated strands 5. This semiconducting casing 6 is in turn surrounded by the main insulation of the cable in the form of an extruded solid insulating layer 7. This insulating layer 7 is surrounded by an external semiconducting casing 8. The conductor area of the cable can vary between 80 and 3000 mm^2 and the external diameter of the cable between 20 and 250 mm.

Whilst the casings 6 and 8 are described as "semi-conducting" they are in practice formed from a base polymer mixed with carbon black or metallic particles and have a volume resistivity of between 1 and 10^5 $\Omega \cdot cm$, preferably between 10 and 500 $\Omega \cdot cm$. Suitable base polymers for the casings 6 and 8 (and for the insulating layer 7) include ethylene vinyl acetate copolymer/nitrile rubber, butyl grafted polythene, ethylene butyl acrylate copolymer, ethylene ethyl acrylate copolymer, ethylene propene rubber, polyethylenes of low density, poly butylene, poly methyl pentene, and ethylene acrylate copolymer.

The inner semiconducting casing 6 is rigidly connected to the insulating layer 7 over the entire interface therebetween. Similarly, the outer semiconducting casing 8 is rigidly connected to the insulating layer 7 over the entire interface therebetween. The casings 6 and 8 and the layer 7 form a solid insulation system and are conveniently extruded together around the wire strands 5.

Whilst the conductivity of the inner semiconducting casing 6 is lower than that of the electrically conductive wire strands 5, it is still sufficient to equalise the potential over its surface. Accordingly, the electric field is distributed uniformly around the circumference of the insulating layer 7 and the risk of localised field enhancement and partial discharge is minimised.

The potential at the outer semiconducting casing 8, which is conveniently at zero or ground or some other controlled potential, is equalised at this value by the conductivity of the casing. At the same time, the semi-conducting casing 8 has sufficient resistivity to enclose the electric field. In view of this resistivity, it is desirable to connect the conductive polymeric casing to ground, or some other controlled potential, at intervals therealong.

The transformer according to the invention can be a one-, three- or multi-phase transformer and the core can be of any design. Figure 2 shows a three-phase laminated core transformer. The core is of conventional design and comprises three core legs 9, 10, 11 and joining yokes 12, 13.

The windings are concentrically wound around the core legs. In the transformer of Figure 2 there are three concentric winding turns 14, 15, 16. The innermost winding turn 14 can represent the primary winding and the two other winding turns 15,16 the secondary winding. To make the Figure more clear such details as connections for the windings are left out. Spacing bars 17,18 are provided at certain locations around the windings. These bars 17,18 can be made of insulating material to define a certain space between the winding turns 14, 15, 16 for cooling, retention etc. or be made of an electrically conducting material to form a part of a grounding system of the windings 14, 15, 16.

The mechanical design of the individual coils of a transformer must be such that they can withstand forces resulting from short circuit currents. As these forces can be very high in a power transformer, the coils must be distributed and proportioned to give a generous margin of error and for that reason the coils cannot be designed so as to optimize performance in normal operation.

The main aim of the present invention is to alleviate the above mentioned problems relating to short circuit forces in a dry transformer.

This aim is achieved by a transformer as defined in claim 1.

By manufacturing the transformer windings from a conductor having practically no electric fields outside an

outer semiconducting casing thereof, the high and low voltage windings can be easily mixed in an arbitrary way for minimizing the short circuit forces. Such mixing would be unfeasible in the absence of the semiconducting casing or other electric field containing means, and would therefore be considered impossible in a conventional oil-filled power transformer, because the insulation of the windings would not withstand the electric field existing between the high and low voltage windings.

It is also possible to reduce the distributed inductance and design the transformer core for the optimum match between window size and core mass.

According to an embodiment of the invention at least some of the turns of the low voltage winding are each split into a number of subturns connected in parallel for reducing the difference between the number of high voltage winding turns and the total number of low voltage winding turns to make the mixing of high voltage winding turns and low voltage winding turns as uniform as possible. Preferably, each turn of the low voltage winding is split into such a number of subturns, connected in parallel, such that the total number of low voltage winding turns is equal to the number of high voltage winding turns. High voltage and low voltage winding turns can then be mixed in a uniform manner such that the magnetic field generated by the low voltage winding turns substantially cancels the magnetic field from high voltage winding turns.

According to another advantageous embodiment, the turns of the high voltage winding and the turns of the low voltage winding are arranged symmetrically in a chessboard pattern, as seen in cross-section through the windings. This is an optimum arrangement for obtaining an efficient mutual cancellation of magnetic fields from the low and high voltage windings and thus an optimum arrangement for reducing the short circuit forces of the coils.

According to still another advantageous embodiment, at least two adjacent layers have substantially equal thermal expansion coefficients. In this way thermal damages to the winding is avoided.

Another aspect of the invention provides a method of winding a power transformer as defined in claim 21.

To explain the invention in more detail, embodiments of the transformer according to the invention will now be described by way of example only with reference to the drawings in which:

Figure 1 shows an example of the cable used in the windings of the transformer according to the invention;

Figure 2 shows a conventional three-phase transformer;

Figures 3 and 4 show in cross-section different examples of the arrangement of the low and high voltage windings of the transformer of the invention; and

Figure 5 shows a method of winding the transformer.

Figure 3 is a cross-section through the portion of the windings of a power transformer according to the invention within the transformer core 22. A layer of a low voltage winding 26 is located between two layers of a high voltage winding 28. In this embodiment the transformation ratio is 1:2.

The direction of the current in the low voltage winding 26 is opposite to the direction of the current in the high voltage winding 28 and the resulting forces from the currents in the low and high voltage winding consequently partially cancel each other. This possibility of reducing the effect of current induced forces is of great importance, especially in case of a short circuit.

Struts 27 of laminated magnetic material, including spacers 29 providing air gaps, are located between the windings 26, 28 for improving transformer efficiency.

Cancellation of short circuit forces can be improved even further by splitting the turns of the low voltage winding into a number of subturns connected in parallel, preferably such that the total number of low voltage turns becomes equal to the number of high voltage winding turns. Thus, if the transformation ratio amounts to e.g. 1:3 each turn of the low voltage winding is split into three subturns. It is then possible to mix the low and high voltage windings in a more uniform pattern. An optimum arrangement of the windings is shown in Figure 4, where low and high voltage winding turns 30 and 32 respectively are arranged symmetrically in a chessboard pattern. In this embodiment the magnetic fields from each turn of the low and high voltage windings 30, 32 substantially cancel each other and short circuit forces are almost completely cancelled.

When splitting a winding turn into a number of subturns the conducting area of each subturn can be reduced correspondingly since the sum of the current intensities in the subturns remains equal to the current intensity in the original winding turn. Thus no more conducting material, (normally copper), is needed when splitting the winding turns, provided that other conditions are unchanged.

Figure 5 schematically shows how the transformer of the invention can be wound. A first drum 40 carries a high voltage conductor 42 and a second drum 44 carries a low voltage conductor 46. The conductors 42, 46 are unwound from the drums 46, 44 and wound onto a transformer drum 48, all three drums 40, 44, 48 rotating simultaneously. Thus the high and low voltage conductors can easily be intermixed. Joints can be provided between different winding layers.

In the transformer of the invention the magnetic energy and hence the stray magnetic field in the windings is reduced. A wide range of impedances can be chosen.

The electrical insulation systems of the windings of a transformer according to the invention are intended to be able to handle very high voltages and the consequent electric and thermal loads which may arise at these voltages. By way of example, power transformers according to the invention may have rated powers in excess of 0.5 MVA, preferably in excess of 10 MVA, more preferably greater than 30 MVA and up to 1000 MVA and have rated voltages from 3 - 4 kV, in particular in excess of 36 kV, and preferably more than 72.5 kV up to very high transmission voltages of from 400 - 800 kV or higher. At high operating voltages, partial discharges, or PD, constitute a serious problem for known insulation systems. If cavities or pores are present in the insulation, internal corona discharge may arise whereby the insulating material is gradually degraded eventually leading to breakdown of the insulation. The electric load on the electrical insulation in use of a transformer according to the present invention is reduced by ensuring that the inner first layer of the insulation system which has semi-conducting properties is at substantially the same electric potential as conductors of the central electrically conductive means which it surrounds and the outer second layer of the insulation system which has semi-conducting properties is at a controlled, e.g. earth, potential. Thus the electric field in the solid electrically insulating layer between these inner and outer layers is distributed substantially uniformly over the thickness of the intermediate layer. By having materials with similar thermal properties and with few defects in these layers of the insulation system, the possibility of PD is reduced at given operating voltages. The windings of the transformer can thus be designed to withstand very high operating voltages, typically up to 800 kV or higher.

Although it is preferred that the electrical insulation should be extruded in position, it is possible to build up an electrical insulation system from tightly wound, overlapping layers of film or sheet-like material. Both the semiconducting layers and the electrically insulating layer can be formed in this manner. An insulation system can be made of an all-synthetic film with inner and outer semiconducting layers or portions made of polymeric thin film of, for example, PP, PET, LDPE or HDPE with embedded conducting particles, such as carbon black or metallic particles and with an insulating layer or portion between the semiconducting layers or portions.

For the lapped concept a sufficiently thin film will have butt gaps smaller than the so-called Paschen minima, thus rendering liquid impregnation unnecessary. A dry, wound multilayer thin film insulation has also good thermal properties.

Another example of an electrical insulation system is similar to a conventional cellulose based cable, where a thin cellulose based or synthetic paper or non-woven material is lap wound around a conductor. In this case the semiconducting layers, on either side of an insulating layer, can be made of cellulose paper or non-woven material made from fibres of insulating material and with conducting particles embedded. The insulating layer can be made from the same base material or another material can be used.

Another example of an insulation system is obtained by combining film and fibrous insulating material, either as a laminate or as co-lapped. An example of this insulation system is the commercially available so-called paper polypropylene laminate, PPLP, but several other combinations of film and fibrous parts are possible. In these systems

various impregnations such as mineral oil can be used.

CLAIMS

1. A power transformer comprising at least one high voltage winding and one low voltage winding, **characterised in** that each of said windings comprises a flexible conductor having electric field containing means but which is magnetically permeable and in that the windings are intermixed such that turns of the high voltage winding are mixed with turns of the low voltage winding.

2. A transformer according to claim 1, **characterised in** that said low voltage winding is wound as a low voltage winding layer positioned between two corresponding adjacent high voltage winding layers.

3. A transformer according to claim 1 or 2, **characterised in** that said windings are arranged in a repeated periodic pattern of one high voltage winding layer, followed by a low voltage winding layer, followed by two high voltage winding layers, followed by a low voltage winding layer, followed by two high voltage winding layers, etc.

4. A transformer according to claim 1 or 2, **characterised in** that each one of at least some of the turns of the low voltage winding is split into a number of subturns connected in parallel for reducing the difference between the number of high voltage winding turns and the total number of low voltage winding turns.

5. A transformer according to claim 4, **characterised in** that each turn of the low voltage winding is split into a number of parallel-connected subturns equal to the number of high voltage winding turns.

6. A transformer according to claim 5, **characterised in** that the turns of the high voltage winding and the turns in the low voltage winding are arranged symmetrically in a

chessboard pattern, as seen in a cross-section through the windings.

7. A transformer according to claim 1 or 2, **characterised in** that the conductor comprises central electrically conductive means, a first layer having semi-conducting properties provided around said conductive means, a solid insulating layer provided around said first layer, and field containing means comprising a second layer having semi-conducting properties provided around said insulating layer.

8. A transformer according to claim 7, **characterised in** that the potential of said first layer is substantially equal to the potential of the conductor.

9. A transformer according to claim 7, **characterised in** that said second layer is arranged to constitute substantially an equipotential surface surrounding said conductor.

10. A transformer according to claim 9, **characterised in** that said second layer is connected to a predetermined potential.

11. A transformer according to claim 10, **characterised in** that said predetermined potential is ground potential.

12. A transformer according to claim 7, **characterised in** that at least two adjacent layers have substantially equal thermal expansion coefficients.

13. A transformer according to claim 7, **characterised in** that said central conductive means comprises a plurality of strands of wire, only a minority of said strands being in electrical contact with each other.

14. A transformer according to claim 7, **characterised in** that each of said three layers is fixedly connected to the adjacent layers along substantially the whole connecting surface.

15. A transformer according to claim 7, **characterised in** that the conductor also comprises a metal shield and a sheath.

16. A transformer according to claim 7, **characterised in** that the cross-section area of the central conductive means is from 80 to 3000 mm^2.

17. A transformer according to claims, **characterised in** that the external diameter of the conductor is from 20 to 250 mm.

18. A transformer according to claim 1 or 2, **characterised in** that struts (27) of laminated magnetic material are located between the windings.

19. A transformer according to claim 1 or 2, **characterised in** that the electric field containing means is designed for high voltage, suitably in excess of 10 kV, in particular in excess of 36 kV, and preferably more than 72.5 kV up to very high transmission voltages, such as 400 kV to 800 kV or higher.

20. A transformer according to claim 1 or 2, **characterised in** that the electric field containing means is designed for a power range in excess of 0.5 MVA, preferably in excess of 30 MVA and up to 1000 MVA.

21. A method of winding a power transformer, comprising simultaneously winding high voltage and low voltage flexible conductors having electric field containing means but which are magnetically permeable, such that turns

of the high voltage winding are intermixed with turns of the low voltage winding.

22. A method according to claim 21, **characterised in** that the high voltage and low voltage conductors are simultaneously unwound from respective drums and wound on to a transformer drum.

ABSTRACT

A power transformer comprising at least one high voltage winding (32) and one low voltage winding (30). Each of the windings includes at least one current-carrying conductor, a first layer having semi-conducting properties provided around said conductor, a solid insulating layer provided around said first layer, and a second layer having semi-conducting properties provided around said insulating layer. The windings are intermixed such that turns of the high voltage winding are mixed with turns of the low voltage winding.

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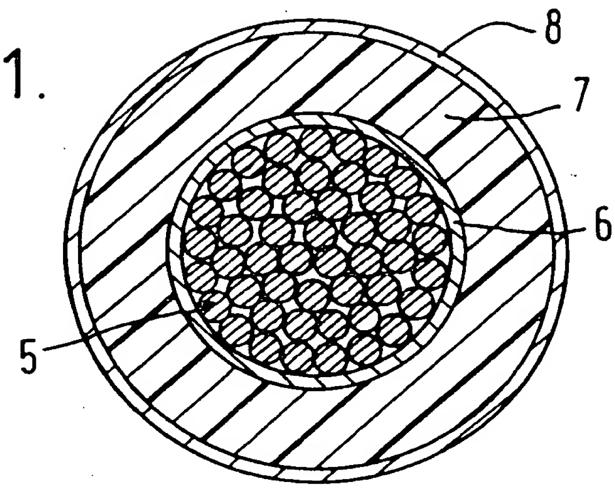
FIG.1.



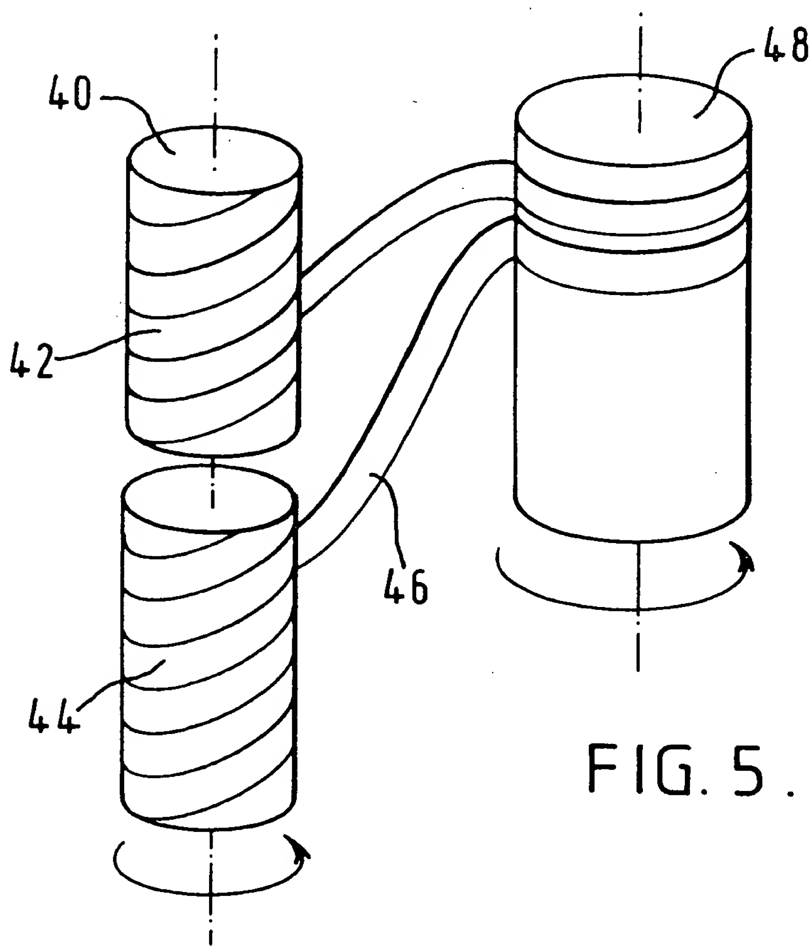


FIG. 5.

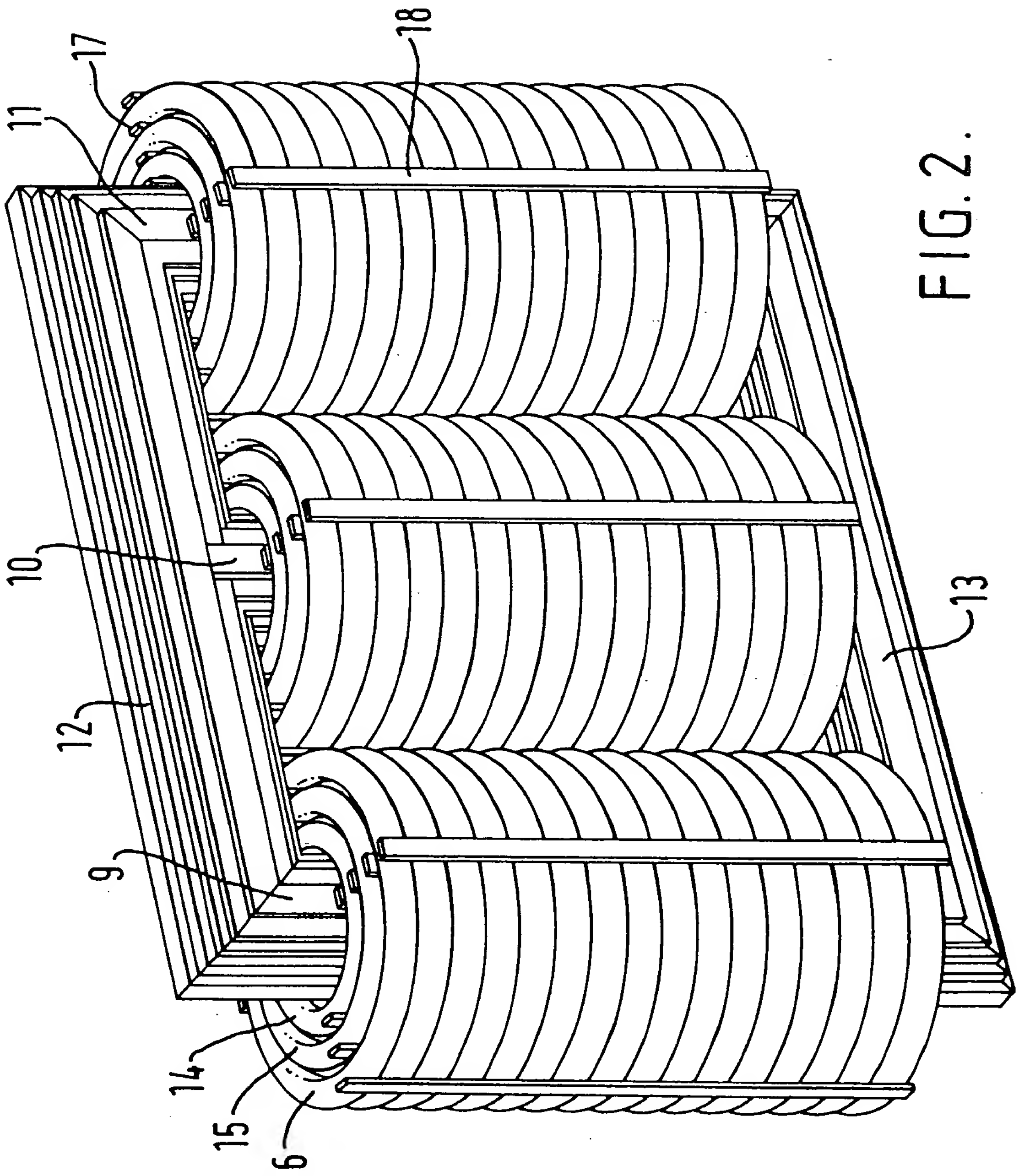
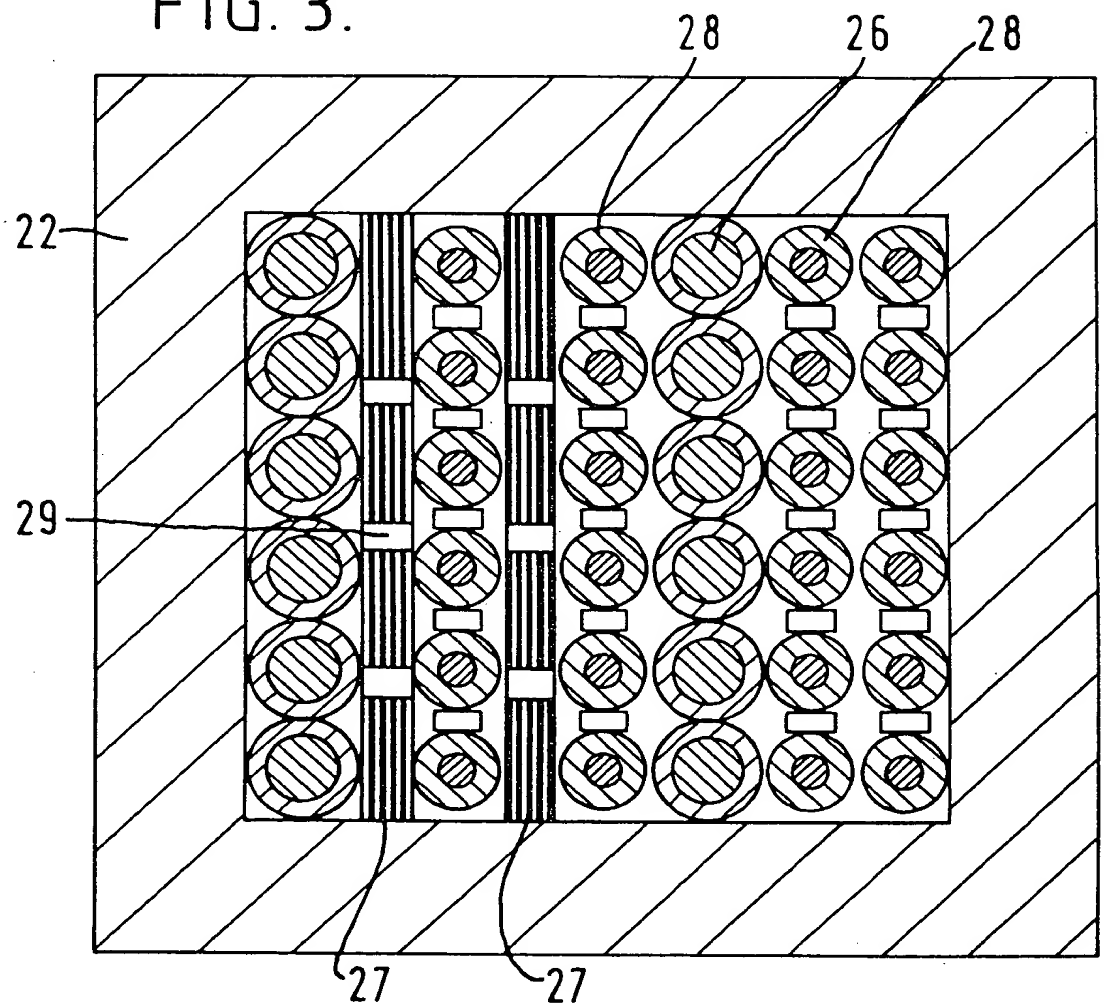


FIG. 2.

FIG. 3.



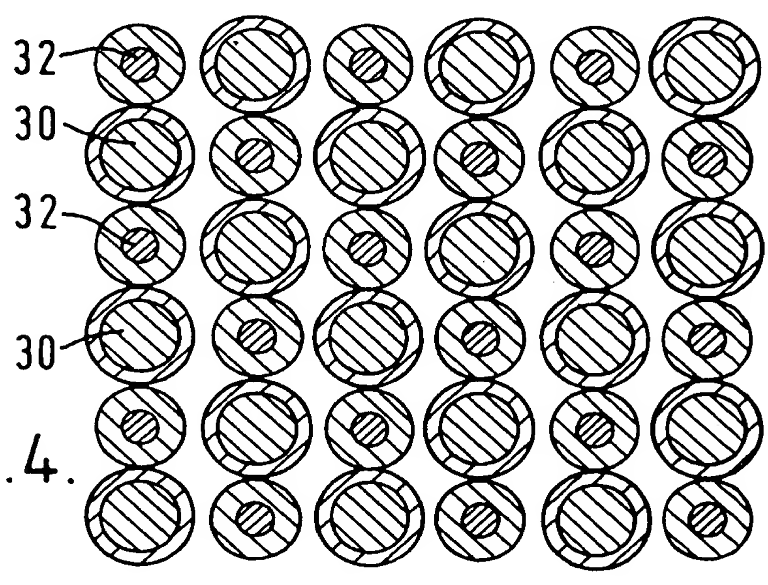


FIG.4.

Patent

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Title	Power transformer and method of winding the same		
IPC	H01F27/28 **&** H01F27/36		

Author / Inventor

SCHUTTE, THORSTEN (**SE**) □F HOLMBERG, PAR (**SE**) □F BRANGEFALT, JAN (**SE**) □F SASSE, CHRISTIAN (**SE**) □F CARSTENSEN, PETER (**SE**) □F

Applicant

Name	**Country**	**Individual/Company**
ABB AB	SE	Company

Priority Data

Country	**Application No**	**Priority Date**
GB	19970025331	1997/11/28

Patent Abstract

A power transformer comprising at least one high voltage winding (32) and one low voltage winding (30). Each of the windings includes at least one current-carrying conductor, a first layer having semi-conducting properties provided around said conductor, a solid insulating layer provided around said first layer, and a second layer having semi-conducting properties provided around said insulating layer. The windings are intermixed such that turns of the high voltage winding are mixed with turns of the low voltage winding.

BACK